State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

STANDING STOCKS OF FISHES
IN SECTIONS OF BIG GRIZZLY CREEK
PLUMAS COUNTY, 1998

by

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INTRODUCTION

The Department of Water Resources (DWR) initiated an instream flow program in 1976 to identify streams that would benefit from flow enhancement, to assess instream values, and identify actions such as habitat manipulation that could enhance these streams. The Northern District of the DWR selected Big Grizzly Creek below Lake Davis (Figure 1) as one of the streams to study under this program.

Previous sampling on Big Grizzly Creek has been conducted by Department of Fish and Game (DFG) biologists. Initial estimates of rainbow trout (Oncorhynchus mykiss) populations were made by the DFG in 1976 (Brown 1976). The DFG also surveyed the creek in 1981, 1986, 1988, 1991, 1994, 1995, 1996, and 1997 to estimate standing stocks of brown trout (Salmo trutta) and rainbow trout in selected stations (Bumpass et al. 1989, Brown 1991a, Brown 1991b, Brown 1992, Brown 1995, Brown 1996, Brown 1997, and Brown 1998).

The purpose of this study is to evaluate the effects of the operation of Lake Davis on populations of trout in Big Grizzly Creek through the periodic sampling of fish at established stations in that creek. These data may also be used to measure the recovery of the trout the DFG planted in Little Last Chance Creek following the rotenone treatment which was conducted in October 1998 to kill northern pike (Esox lucius) in Lake Davis.
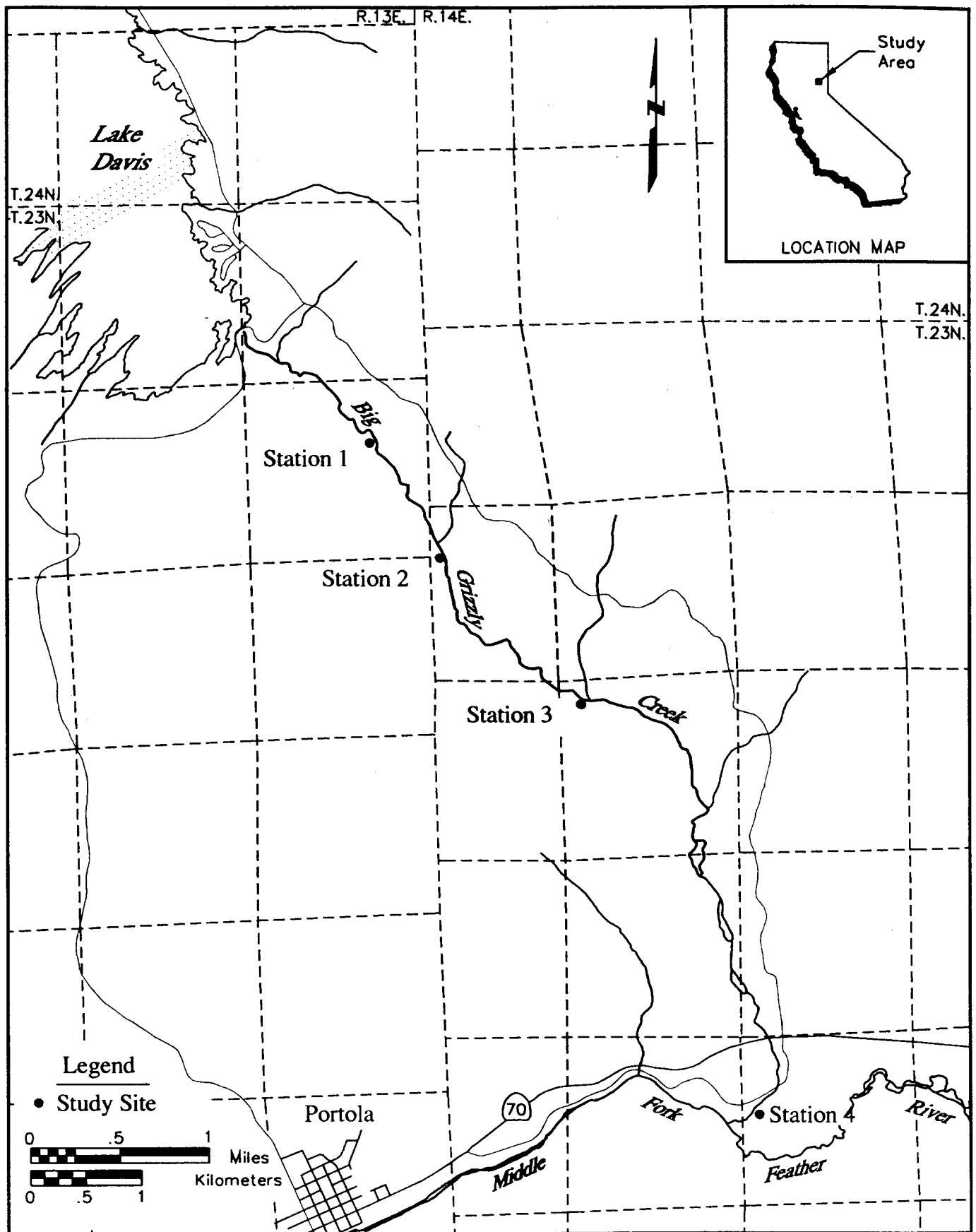
Figure 1. Stations sampled to estimate standing crop of trout in Big Grizzly Creek, Plumas County, 1998.

NAMES OF FISHES

The following species of fishes were caught in this study: rainbow trout, brown trout, Sacramento sucker (Catostomus occidentalis), and largemouth bass (Micropterus salmoides).

METHODS

Physical Measurements

Standing stocks of fishes were estimated at four stations in Big Grizzly Creek in September 1998, prior to rotenone treatment (Figure 1). Stations were intentionally selected to be near stations sampled in previous DFG studies (Gerstung 1973). Markers had previously been placed in trees along the stream to identify station boundaries. Stations varied in length from 53.0 to 89.6 m (Appendix 1). The length and width of each station was measured with metric tape measures.

Biological Measurements

Fish were captured with a battery-powered backpack electroshocker in stream sections blocked by seines as described by Platts et al. (1983). Captured fish were removed from the net-enclosed section on each pass. Standing stock estimates were developed using the two-count method of Seber and LeCren (1967) or the multiple-pass method of Leslie and Davis (1939) with limits of confidence computed using a formula proposed by DeLury (1951).

The weights of trout were measured by displacement. Fork length (FL) of each fish caught was measured to the nearest millimeter.

Scale samples were taken from brown trout and rainbow trout over 100 mm in length. Scales were taken just above the lateral line between the dorsal and adipose fin (Scarnecchia 1979) and placed in a piece of paper inserted in a small coin envelope (Drummond 1966). Scales were mounted dry between microscope slides, and their images were projected on a NCR microfiche reader at a magnification of 42x. Scale measurements for the calculation of growth were recorded to the nearest millimeter along the anterior radius of the anterior-posterior axis of the scale. Estimation of instantaneous population growth rate was calculated (Ricker 1975) with significant values of correlation coefficients taken from a table (Steel and Torrie 1960).

Instantaneous population growth rate $= b(\log_e l_2 - \log_e l_1)$

b = between ages functional slope
l_1 = initial length for the last complete year of growth
l_2 = final length for the last complete year of growth

Standing crops of brown trout and rainbow trout were calculated for individual stations where each species was caught and then combined for the entire creek. Age and growth were calculated for the population (Everhart et al. 1975). Length-weight relationships were determined for both brown trout and rainbow trout (Lagler 1956). The coefficient of condition and 95 percent confidence intervals were calculated for all trout (Carlander 1969). The distribution of all fish caught is listed according to location.

RESULTS

Distribution

Rainbow trout and brown trout were caught at each station. Sacramento suckers were caught in station 3. Largemouth bass were caught in station 4, the lowest station sampled (Table 1).

TABLE 1. Distribution of fishes in sections of Big Grizzly Creek, Plumas County, 1998.

	Station Number			
	1	2	3	4
Distance Below Grizzly Valley Dam (km)	2.5	3.2	4.8	9.7
Brown trout	X	X	X	X
Rainbow trout	X	X	X	X
Sacramento sucker			X	
Largemouth bass				X

Standing Crop

Rainbow trout was the most common game fish caught in Big Grizzly Creek. Biomass averaged 1.6 g/m² in four stations (Table 2). Catchable rainbow trout (trout greater than or equal to 127 mm FL) biomass averaged 0.5 g/m². We found brown trout in all four stations. Biomass of brown trout was 3.1 g/m² (Table 3). Catchable brown trout biomass averaged 2.7 g/m². Biomass was not estimated for Sacramento suckers or largemouth bass.

Table 2. Estimate of rainbow trout standing crop in Big Grizzly Creek, Plumas County, 1998.

Distance Below Grizzly Valley Dam (km)	Population Estimate	95% Confidence Interval	Biomass (g/m^2)	Estimate of Catchable Trout ($\geq$ 127 mm FL)	Biomass of Catchable Trout (g/m^2)
2.5	15	14-20	1.7	4	1.1
3.2	47	36-70	2.5	0	0
4.8	3	3-6	0.1	0	0
9.7	100	20-828	2.2	1	1.0

Table 3. Estimate of brown trout standing crop in Big Grizzly Creek, Plumas County, 1998.

Distance Below Grizzly Valley Dam (km)	Population Estimate	95% Confidence Interval	Biomass (g/m^2)	Estimate of Catchable Trout ($\geq$ 127 mm FL)	Biomass of Catchable Trout (g/m^2)
2.5	1	1-1	0.1	0	0
3.2	7	7-9	2.7	1	2.5
4.8	0	0	0	0	0
9.7	160	73-342	9.4	20	8.3

Length and Weight

Age group 0+ rainbow trout represented 77 percent of the 73 rainbow trout caught. Ages 1+ and 2+ comprised 19 percent and 4 percent respectively (Figure 2 and Appendix 2). Age group 0+ brown trout made up 79 percent of the 81 brown trout caught. Age 1+ comprised 11 percent and age 2+ made up 8 percent . Age class 3+ brown trout made up 2 percent of the total catch (Figure 3 and Appendix 3).
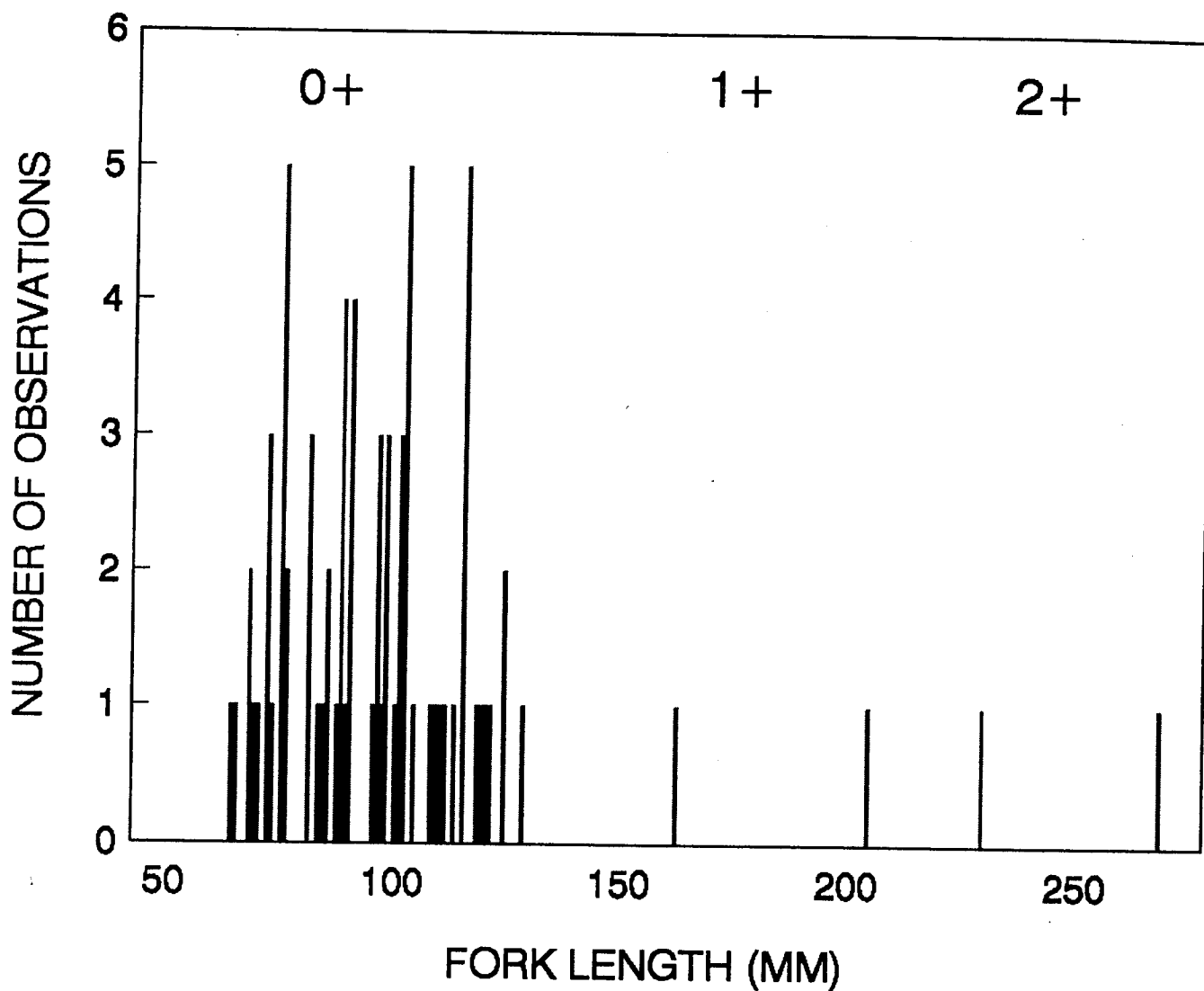
FIGURE 2. Length, observed frequency, and
age of rainbow trout caught in Big Grizzley Creek.
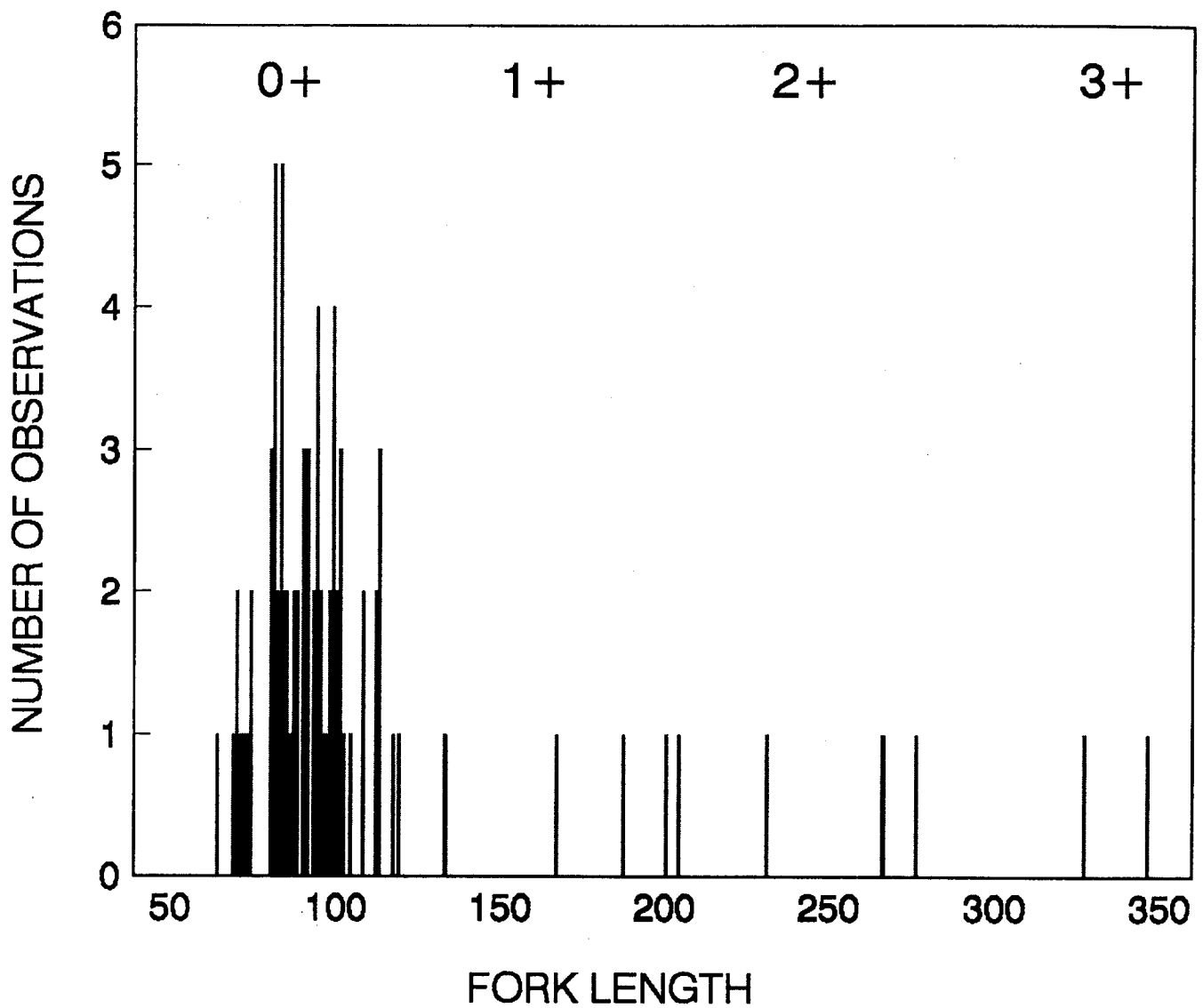Plumas County, 1998.

FIGURE 3. Length, observed frequency, and age of brown trout caught in Big Grizzly Creek, Plumas County, 1998,

The relationship between fork length and weight (W) of rainbow trout for Big Grizzly Creek is:

$$Log_{10}W = -4.9 + 3.0 \ Log_{10}FL$$

$$r^2 = 0.98$$

$$N = 73 \quad \text{(Figure 4 and Appendix 2)}$$

The same relationship for brown trout is:

$$Log_{10}W = -5.0 + 3.0 \ Log_{10}FL$$

$$r^2 = 0.99$$

$$N = 81 \quad \text{(Figure 5 and Appendix 3)}$$

Age and Growth

The formula $FL = -21.7 + 0.8 \ S$ describes the relationship between the fork length and enlarged scale radius (S) of 5 rainbow trout caught in Big Grizzly Creek. The coefficient of correlation (r^2) is 0.90. The formula was $FL = 148.5 - 0.5 \ S$ for 6 brown trout, while the value for r^2 is 0.25.

$Log_{10} W = -4.9 + 3.0 Log_{10} FL$

$r^2 = 0.98$

$N = 73$

FIGURE 4. The relationship between length and weight of rainbow trout caught in sections of Big Grizzly Creek, Plumas County, 1998.

$$Log_{10} W = -5.0 + 3.0 Log_{10} FL$$

$$r^2 = 0.99$$

$$N = 81$$
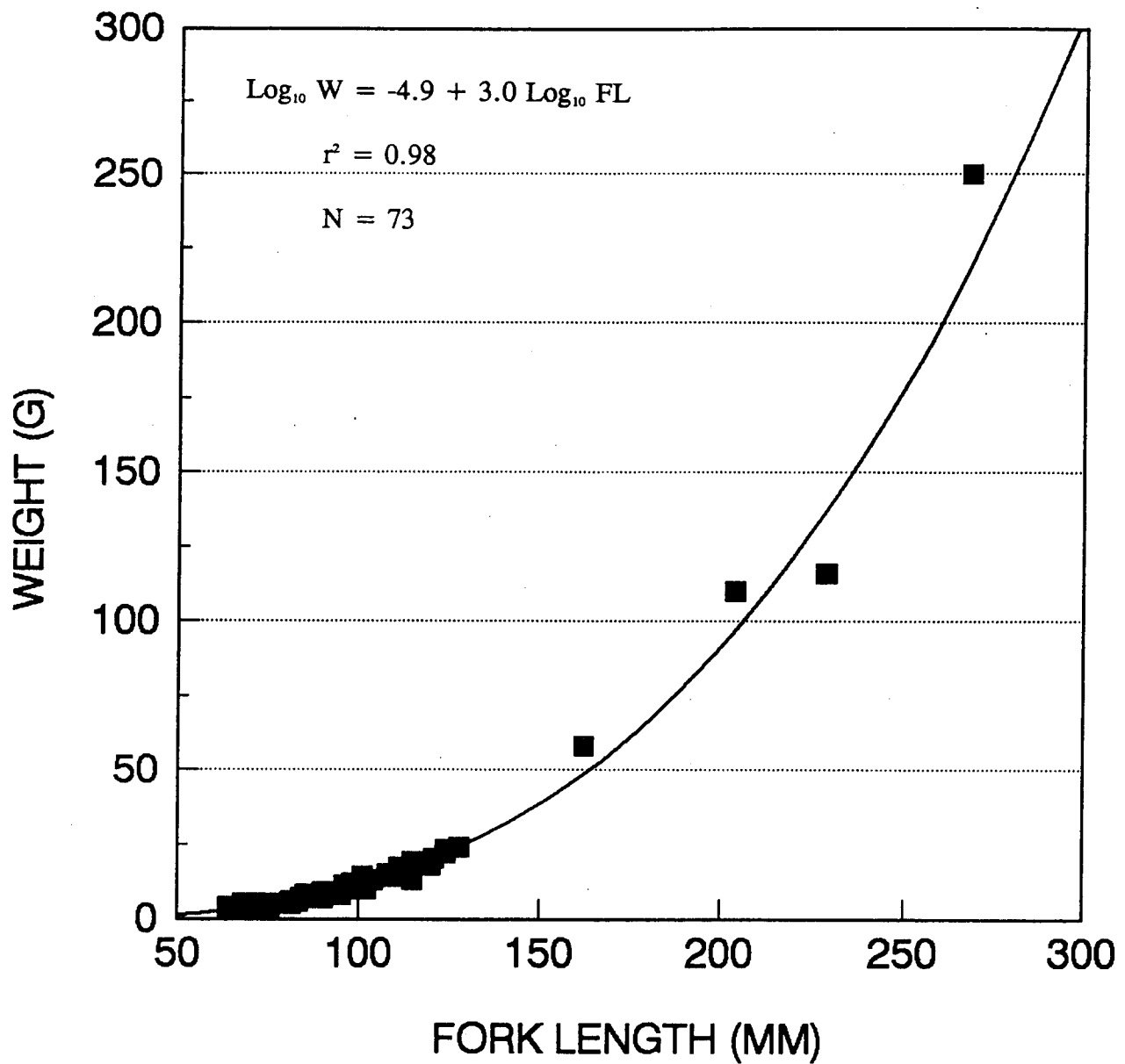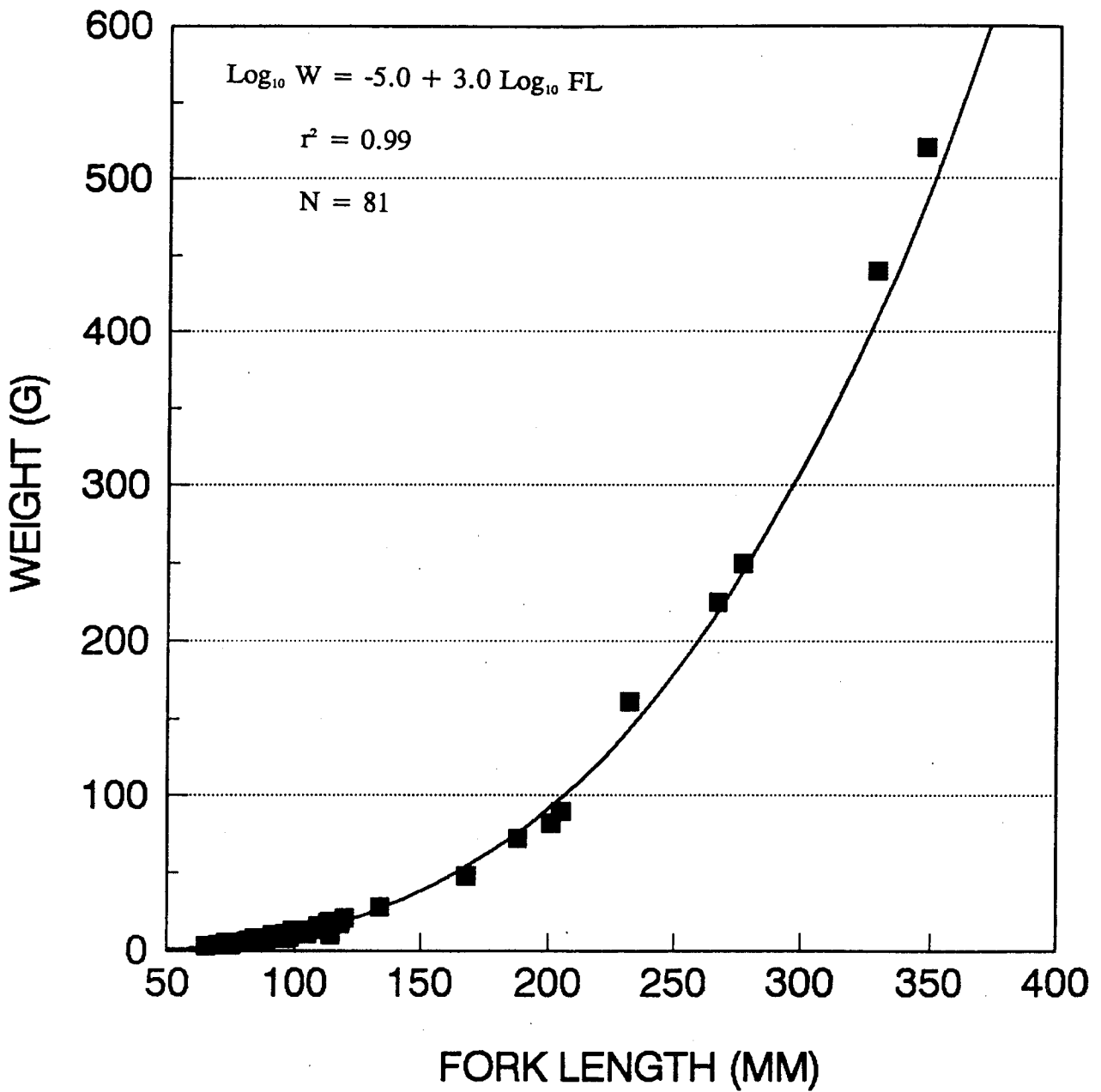
FIGURE 5. The relationship between length and weight of brown trout caught in sections of Big Grizzly Creek, Plumas County, 1998.

Population growth and mean individual growth were greater for brown trout than rainbow trout (tables 5 and 6).

Table 5. Growth rates for rainbow trout caught in Big Grizzly Creek, 1998.

Age	Population Growth			Mean Individual Growth		
	Length Interval (mm)	Difference of Natural Logarithms	Instantaneous Growth Rate Gx	Length Interval (mm)	Difference of Natural Logarithms	Instantaneous Growth Rate Gx
1-2	122-184	0.411	1.233	97-184	0.640	1.921

Table 6. Growth rates for brown trout caught in Big Grizzly Creek, 1998.

Age	Population Growth			Mean Individual Growth		
	Length Interval (mm)	Difference of Natural Logarithms	Instantaneous Growth Rate Gx	Length Interval (mm)	Difference of Natural Logarithms	Instantaneous Growth Rate Gx
1-2	114-183	0.473	1.420	116-183	0.456	1.368
2-3	183-243	0.284	0.851	213-243	0.132	0.395

Age 1+ rainbow trout averaged 183 mm fork length and age 2+ rainbow trout averaged 234 mm fork length (Table 7). Age 1+ and age 2+ brown trout averaged 191 mm and 250 mm, respectively. One age 3+ brown trout was 328 mm fork length (Table 8).

Table 7. Calculated fork length of rainbow trout from Big Grizzly Creek, 1998.

Age	Number of Fish	Length at Capture	Length at Successive Annulus	
			1	2
1	2	183	122	
2	3	234	97	184
Number of back-calculations			2	3
Weighted means (mm)			107	184
Increments (mm)				77

Table 8. Calculated fork length of brown trout from Big Grizzly Creek, 1998.

Age	Number of Fish	Length at Capture	Length at Successive Annulus		
			1	2	3
1	3	191	114		
2	2	250	116	183	
3	1	328	102	213	243
Number of back-calculations			6	3	1
Weighted means (mm)			113	193	243
Increments (mm)				80	50

Coefficient of Condition

The average coefficient of condition for 73 rainbow trout was 1.1563 and 1.1322 for 81 brown trout. Age 0+ rainbow trout had slightly higher coefficients of condition than brown trout of the same age group (Table 9).

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Table 9. Condition of rainbow trout and brown trout in Big Grizzly Creek, Plumas County, 1998.

Age Group	Number of Trout	Coefficient of Condition	95% Confidence Interval
Rainbow trout			
0+	56	1.1551	0.9033-1.4069
1+	14	1.1554	0.9356-1.3731
2+	3	1.1868	0.8807-1.4929
Combined	73	1.1563	0.9076-1.4049
Brown trout			
0+	64	1.1335	0.9308-1.3363
1+	9	1.0986	0.7608-1.4364
2+	6	1.1309	0.9448-1.3171
3+	2	1.2457	
Combined	81	1.1322	0.9099-1.3546

DISCUSSION

Summer streamflow in Big Grizzly Creek has generally been between 0.6 and 0.3 cms from 1974 to 1993. Higher flows occurred in 1977 and 1979 (Table 10). Haines (1982) reported that optimum flow for rainbow trout was 0.6 cms. Her recommendation was based on an instream flow study that the DWR conducted in 1981. The DWR bases flow releases from Lake Davis on lake water levels in the spring. Lake water levels were low from 1988 through 1994 so minimum releases (0.3 cms) were the rule.

Table 10. Average summer streamflow in Big Grizzly Creek, 1974-1998.

Year	Flow (cms)	Year	Flow (cms)
1974	0.7	1987	0.5
1975	0.4	1988	0.3
1976	0.3	1989	0.3
1977	1.8	1990	0.3
1978	0.3	1991	0.3
1979	2.2	1992	0.3
1980	0.4	1993	0.3
1981	0.3	1994	0.3
1982	0.6	1995	0.6
1983	0.6	1996	0.6
1984	0.6	1996	0.6
1985	0.5	1997	0.6
1986	0.6	1998	0.6

Biomass of rainbow trout has averaged 3.4 g\m² and ranged from 1.0 to 7.3 g\m² since we began sampling in 1976 (Table 11). There is no significant correlation between streamflow and biomass (r^2 = 0.001) because rainbow trout biomass was lower in 1986 and 1995 than we expected from the relative high summer flows that were released that year. Brown trout biomass has averaged 1.1 g/m² and ranged from 0 to 3.8 g/m². Brown trout biomass is not correlated with flow ($p > 0.05$)

Table 11. Biomass (g/m²) of rainbow and brown trout
in Big Grizzly Creek.

Year	Rainbow trout	Brown trout
1976	1.9	-
1981	1.8	0.1
1986	3.2	3.8
1988	5.6	0.4
1994	2.2	0.7
1995	1.0	0.5
1996	4.5	0.5
1997	7.3	2.2
1998	1.6	3.1

Estimated numbers of catchable-size rainbow trout have been well below average since we began sampling Big Grizzly Creek (Table 12). Catchable-size rainbow trout averaged 0.04 trout/m² and catchable-size brown trout averaged 0.02 trout/m². High numbers of rainbow trout and brown trout in 1997 should have been the result of four years of favorable flow in Big Grizzly Creek. These fish, however, were trout planted by the DFG in 1998 to replace trout killed by rotenone that killed most fish in Big Grizzly Creek during the October 1998 poisoning of Lake Davis or trout that migrated upstream from the Feather River. The growth rates of recently planted trout does not reflect stream conditions in Big Grizzly Creek for that year (Table 10).

Table 12. Density of catchable-size rainbow and brown trout
(trout/m²) in Big Grizzly Creek.

Year	Rainbow trout	Brown trout
1981	0.01	0
1986	0.04	0.08
1988	0.09	0.02
1994	0.02	0.02
1995	0.03	0.01
1996	0.04	0.01
1997	0.05	0.01
1998	0.01	0.02

Growth of rainbow and brown trout in 1998 was the lowest we have recorded since

we started to sample in 1981 (Table 13). The low growth of these trout may be due to lack

of insects they eat. Rotenone killed the insects and they may have been slow to recolonize

(Cook and Moore 1969). It may also be due to the hatchery trout that the DFG planted. They

grow slowly in a new environment (Mason et al. 1967, Fay and Pardue 1986).

Table 13. Growth of age 1-2 rainbow and brown trout in Big Grizzly Creek.

Year	Rainbow trout	Brown trout
1981	1.892	-
1986	1.416	-
1988	1.534	1.534
1994	1.747	1.888
1995	2.219	2.429
1996	1.973	2.273
1997	2.289	2.298
1998	1.233	1.420

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APPENDIX 1

PERMANENT FISH POPULATION STATIONS FOR
BIG GRIZZLY CREEK, PLUMAS COUNTY
SEPTEMBER, 1998

Station 1 (Stream Gage Station) - Station 1 is located 1.8 stream km below Grizzly Valley
Dam and just downstream from an abandoned USGS stream gage at an elevation of 1622 m
MSL. The station begins at a concrete weir near a stream gage (UTM 170 167). The stream
within the station is a riffle (67%) with several split channels and small pocket pools that
ends in a long, shallow pool (33%). It is 60.7 m long and has a surface area of 384.8 m^2 at
0.56 cms. Substrate is 75% boulders, 15% rubble, and 10% sand.

Station 2 (IFN Station) - Station 2 is 3.1 stream km below Grizzly Valley Dam. The site
located at UTM 176 156 at an elevation of 1610 m MSL. The upper end of the station is a
steep rapid (55%) followed by two deep pools (45%) separated by short rapids. The
substrate is mostly rubble (60%), boulder (20%), gravel (10%), with areas of sand (10%) in
the pools. The station is 56.7 m long with a surface area of 206.7 m^2 at 0.56 cms.

Station 3 (3-Mile Station) - Station 3 is located 5.2 km downstream from Grizzly Valley
Dam at an elevation of 1549 m MSL at UTM 189 141. The station begins in a steep rapid
followed by more gradual rapids (75%) with pocket pools and two larger pools (25%) near
the lower end. Substrate is boulder (65%), rubble (20%), sand (10%), and gravel (5%).
The station is 53.0 m long and has a surface area of 287 m^2 at 0.56 cms.

Station 4 (6-Mile Station) - Station 4 is located 10.4 km below Grizzly Valley Dam and 0.2
km above the confluence with the Middle Fork Feather River at an elevation of 1488 m
MSL. It is located at UTM 205 106. The station begins in a rapid just above a large 0.7 m
deep pool (33%) followed by several riffle areas (67%) and shallow pools with undercut
banks and overhanging grass clumps. Substrate is rubble (10%), gravel (75%), bedrock
(10%), and mud (5%). The station is 89.6 m long with a surface area of 466.8 m^2 at 0.56
cms.

LENGTH AND WEIGHT OF RAINBOW TROUT
CAUGHT IN BIG GRIZZLY CREEK, 1998

Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)
64	4	76	5	90	8	102	13
65	3	81	6	90	8	102	10
68	4	81	5	95	8	102	11
68	5	81	6	96	10	104	13
69	4	83	6	96	10	108	15
70	4	84	7	96	11	109	14
72	4	85	8	97	11	110	15
72	5	85	7	98	12	111	17
72	5	87	8	98	11	113	17
73	4	88	8	98	11	115	19
75	5	88	7	100	10	115	18
75	4	88	7	101	12	115	13
75	5	88	8	101	12	115	18
75	5	89	8	101	14	115	19
75	4	90	9	102	13	118	18
76	5	90	7	102	12	119	19

APPENDIX 2

LENGTH AND WEIGHT OF RAINBOW TROUT
CAUGHT IN BIG GRIZZLY CREEK, 1998
(Continued)

Fork Length (mm)	Weight (g)
120	18
121	20
124	23
124	22
128	24
162	58
204	110
229	116
268	250

APPENDIX 3

LENGTH AND WEIGHT OF BROWN
TROUT CAUGHT IN BIG GRIZZLY CREEK, 1998.

Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)
65	3	82	6	89	8	98	9
70	4	83	7	91	8	99	13
71	4	83	7	91	8	99	12
71	4	84	7	91	10	100	11
72	4	84	7	92	8	100	11
73	5	84	6	92	10	100	12
74	5	84	7	92	9	100	12
75	4	84	8	94	10	101	12
75	5	85	7	94	9	101	12
81	6	85	8	95	10	102	12
81	6	86	6	95	10	102	12
81	6	86	7	95	9	102	12
82	5	87	7	95	10	103	13
82	7	88	8	96	11	105	11
82	5	88	7	96	8	109	16
82	6	89	8	97	10	109	14

APPENDIX 3

LENGTH AND WEIGHT OF BROWN TROUT CAUGHT
IN BIG GRIZZLY CREEK, 1998.
(Continued)

Fork Length (mm)	Weight (g)
113	18
113	16
114	19
114	10
114	17
118	17
120	21
134	28
168	48
188	72
201	82
205	90
232	161
267	225
277	250
328	440
347	520